Appendix E

Draft Neutralization Options

May 25, 2006

DRAFT Neutralization Options for Lake Davis Pike Eradication Project

The draft EIR/EIS will examine four different options for addressing the outflow from Grizzly Valley Dam into Big Grizzly Creek during the proposed rotenone treatment of Lake Davis, Plumas County as part of the Proposed Project. All of the options will require that neutralization personnel be housed on-site for daily living requirements. A portable house trailer and portable toilet will be installed at the staging area at the base of the dam. The neutralization station will require between 10-15 persons during initial startup then scaled back to operational levels for the duration of the treatment. Only Option 1 will require fewer personnel due to the lack chemical neutralization. The neutralization station will be operated 24 hours per day for the duration of the project (up to 45 days).

Options 1, 2, and 3 include a significant lowering of flow in Big Grizzly Creek. A fish rescue would occur prior to the rotenone treatment. CDFG, DWR, and local citizens would use nets to transport fish downstream of the area expected to be affected by dewatering of the streambed. The flow lowering would be ramped over several days to allow most fish to move downstream volitionally. As the flow reached a low, safe and wadeable level, as many fish as could be caught would be netted and transported to a fish transport truck that would take them to a site (to be determined) downstream.

Option 1

Prior to the application of rotenone to Lake Davis, the Grizzly Valley dam outlet valve would be completely shut off resulting in the flow of Big Grizzly Creek being reduced to approximately 4 gallons per minute (gpm) leakage at the base of the dam from toe drains and weep holes. No or insignificant leakage from the valve itself is expected. Approximately 200 to 300 feet downstream of the dam accretion flow increases to 30 to 60 gpm[1]. The leakage flow from the dam would be collected in a 30 to 60 gallon collection reservoir located immediately downstream of the Division of Safety of Dams (DSOD) measurement devices sited at the base of the dam. This water would either be pumped directly back up into the reservoir (Scenario 1) or into a water tanker truck which would transport the 'raw' (non-neutralized) water back up to the reservoir and release it back into the lake (Scenario 2).

The first scenario of Option 1 includes the following parameters:

- Capture of the approximately 4 gpm leakage water in a 30 to 60 gallon collection reservoir located immediately downstream of the DSOD measurement devices located at the base of the dam. The pumping would continue until there is no detectable rotenone in the reservoir.
- It is estimated that a 1 hp electric (120V) submersible pump immersed in the 30 – 60 gallon collection tank would pump the water via a pvc conduit back up to the top of the dam and discharge the non-detoxified water back into the reservoir. The pvc conduit

[1] DWR. 2006. Grizzly Valley Dam Outflow Curtailment Impact Study: Summary Report

would be routed via the spillway channel and temporarily secured with weighted sandbags.

- The pump system and plumbing would have a complete backup system should the primary system sustain a failure.
- Two 110 pound cans of potassium permanganate would be located on site in case of spill, leakage or other failure of the system.
- The neutralization station and water pumping would be continuously monitored to ensure that every component is functioning properly.
- The operation of the pump back would continue until fish are able to survive in Lake Davis.

The second scenario of Option 1 includes the following parameters:

- Capture of the approximately 4 gpm leakage water in a 30 to 60 gallon collection reservoir located immediately downstream of the DSOD measurement devices located at the base of the dam. The pumping would continue until there is no detectable rotenone in the reservoir.
- It is estimated that a ½ hp electric (120V) submersible pump would pump the water via a pvc conduit up the staging area below the dam and discharge it into a water tanker truck. The estimated 4 gpm leakage would amount to 240 gallons per hour (gal/hr) or 5,760 gal/day. Assuming a 4,000 gallon capacity tanker truck would be used to haul and subsequently dump the water back into the lake, two trucks would need to be stationed at the site. A manifold with a control valve would be used to ensure that at no time would the water not be pumped into a transport vessel. There would be two trips per day until there is no detectable rotenone in the reservoir.
- The truck loading area would be contained by a leak-proof containment area that would have two 110 lb. tins of potassium permanganate on site should a spill occur.
- The neutralization and water pumping station would be continuously monitored to ensure that every component is functioning properly.
- The operation of the pump/truck transfer would continue until fish are able to survive in Lake Davis.

Option 2

This option would shut off the release flows from Grizzly Valley Dam with only the leakage flows (≈ 4 gpm from the base of the dam) occurring for up to 5 days after the application of rotenone begins in Lake Davis. Release flows from the Lake Davis outlet valve would resume from 0.2 to 0.5 cubic feet per second (cfs). The flow would be collected downstream of the DWR pike containment structure, which is under construction. The flow would then be pumped via a pipe to the neutralization station. The neutralization station would be located at the staging area at the base of the dam. Potassium permanganate would be added at 2 to 4 mg/L and then the mixture would enter a reaction vessel. The reaction vessel would need to have a holding time of 30 minutes to allow for complete neutralization of the rotenone. At

0.5 cfs, the tank capacity required would be 6,750 gallons. See Table 1.0 for additional flow release rates and reaction vessel sizes. Two reaction vessels would be necessary to ensure that all of the potassium permanganate has adequate time to neutralize the rotenone. After leaving the reaction vessel the flow would then enter a series of tanks that would contain granular activated carbon (GAC) or another substance. The final filtration component is intended to remove all of the residual potassium permanganate that had not been oxidized by the rotenone in the release water. To our knowledge, a GAC system has never been designed, laboratory-tested, constructed or used to neutralize rotenone or remove $KMNO_4$. In addition, space availability and constraints for housing the system at the staging area will be based upon the size of the reaction/filtration system.

Sentinel fish would be located upstream of the pump conveying flow to the neutralization station, at the 15-minute flow travel mark, at the 30-minute mark, and at the 60-minute mark. The sentinel fish would be provided by a DFG hatchery and held nearby for continual restocking of the live cars throughout the duration of the neutralization operation. The live cars would contain 3 to 5 fish each. The live cars would be located in slack water areas to reduce stress levels. The fish located between the dam and the neutralization site would be replenished once per day to ensure that toxicity is still occurring in the release flows. Fish at the 15-minute and 30-minute marks would be checked every 2 to 4 hours and stressed, injured, or dead fish would be replaced as necessary. Fish at the 60-minute mark would be checked every 6 hours. All fish would be replaced daily.

- The potassium permanganate would be added to the neutralization tank with an 115V electric volumetric auger with a hopper and a variable speed controller.
- The release flow of 0.5 cfs and $KMnO_4$ concentrations ranging from 2 to 4 mg/L would require the granular potassium permanganate to be administered at a rate of 1.7 to 3.4 grams/min. The total amount of potassium permanganate that would be administered for varying durations of neutralization range from 75 to 486 pounds.
- Two 10,000 gallon capacity reaction vessels would be required to ensure 30-minute residence time for $KMnO_4$ laden water. The vessels are 12 feet in diameter and 13.5 feet tall.
- The neutralization of the rotenone laden water from the outlet would last from 14 to 45 days depending on rate of the breakdown of the rotenone in the lake.
- Water samples from the end of pipe after the GAC filters would be analyzed with a colorimeter to verify that $KMnO_4$ concentrations are minimal or below detection.[2]
- Water samples would also be collected every two hours for laboratory analysis for parameters outlined in the water quality monitoring plan.
- The neutralization station would be contained within a leak proof berm area to ensure that any leaks and spills would be contained and not enter the stream.

[2] Parmenter, S.C. & R.W. Fujimura, 1995. *Application and regulation of potassium permanganate to detoxify rotenone in streams*. Proceedings of the Desert Fishes Council 26:62-67.

Table 1.0. $KMnO_4$ Reaction Vessels sizes for varying instream flow releases

Release Rate	GPM	Gal/ 30 min	Vessel Size	Foot Print (ft^2)*
0.2	90	2700	3000	~100 ft^2
0.3	135	4050	5000	~120 ft^2
0.4	180	5400	7500	~120 ft^2
0.5	225	6750	10000	~150 ft^2

*Foot print needs to be doubled to accommodate two reaction vessels. (No matter the flow rate, there would need to be two reaction vessels) Footprint estimate does not include space required for GAC filtration system. Containment berms would need to be large enough to accommodate access to plumbing and reaction vessels

Option 3

This option examines instream neutralization using granular potassium permanganate at 2 to 4 mg/L with the objective of maintaining a target concentration of $KMnO_4$ of 0.5 to 1.0 mg/L at the 30-minute flow travel station located approximately 1/3 mile downstream of Grizzly Valley Dam. The target value of 0.5 to 1.0 mg/L $KMnO_4$ provides the capability to neutralize any rotenone that may not have oxidized during the 30-minute travel time downstream of the dam. This option would shut off the release flows from Grizzly Valley Dam with only the leakage flows (≈ 4 gpm from the base of the dam) occurring for up to 5 days after the application of rotenone begins in Lake Davis. The cessation of flows would allow the rotenone formulation in the reservoir to completely mix thereby reducing the chances for higher concentration plumes of rotenone to pass downstream through the neutralization station. Water sampling results from Lake Davis in 1997 indicated that the reservoir completely mixed within 24 to 48 hours after the application of rotenone. After 5 days, the instream flow releases to Big Grizzly Creek would be resumed at 1 to 2 cfs. This option would require that 750 pounds of potassium permanganate be onsite to complete the neutralization.

The site of this neutralization station would be located at the staging area at the base of the dam. The potassium permanganate would be discharged directly to the stream flows at a concentration ranging from 2 to 5 mg/L to allow for complete neutralization of the rotenone. The potassium permanganate would be applied using an 115V electric volumetric feeder auger. The auger would be powered using either onsite electric power or 2000 watt, gasoline powered generators. A backup system using 2.5% solution $KMnO_4$ would be onsite should the granular application system fail. The 2.5% solution $KMnO_4$ would be dispensed from slurry reservoirs that would be located adjacent to the granular volumetric augers. The reservoirs would be contained within berms to ensure that leakage or vessel failures would be contained.

Sentinel fish would be located between the dam and the neutralization station, at the 15-minute flow travel mark, at the 30-minute mark, and at the 60-minute mark. The sentinel fish would be provided by a DFG hatchery and held nearby for continual restocking of the live cars throughout the duration of the neutralization operation. The live cars would contain 3 to 5 fish each. The live cars would be located in slack water areas to reduce stress levels. The fish located between the dam and the neutralization site would be replenished once per day to ensure that toxicity is still occurring in the release flows. Fish at the 15-minute and

30-minute marks would be checked every 2 to 4 hours and stressed, injured, or dead fish would be replaced as necessary. Fish at the 60-minute mark would be checked every 6 hours. All fish would be replaced daily.

Approximately 24 hours prior to shutting off the flow releases from the Grizzly Valley Dam the application of granular potassium permanganate would begin. This would allow the pre-oxidization of the neutralization zone downstream of the dam to the 30-minute mark (distance = ≈1/3 mile). Potassium permanganate would be discharged at 2 to 4 mg/L to ensure that the full range of delivery is tested. The 2.5% $KMnO_4$ slurry solution would also be tested after the granular tests are performed. The 2.5% solution would be released at 2 to 4 mg/L to ensure that the valves on the slurry reservoirs are properly calibrated. Concentrations of dissolved $KMnO_4$ would be measured and recorded at the 2-minute and 30-minute marks every ¼-hour using a colorimeter.

After completion of the pre-oxidization of the stream channel, the releases would be shut off for 5 days to allow the rotenone in the reservoir to thoroughly mix. The leakage of approximately 4 gpm from the toe drains and weep holes would need to be captured using techniques described in Option 1 above. The leakage water would be tested hourly for rotenone concentration and other constituents described in the Water Monitoring Plan.

After 5 days and determining that the reservoir has completely mixed, the streamflow outlet valves would then be opened to release the 1-2 cfs flow into Big Grizzly Creek. Neutralization would commence immediately using the volumetric auger. Discharge of the granular potassium permanganate would be measured bi-hourly using an electronic balance. Volumetric discharge of the granular potassium permanganate would be dependant upon the constant feedback of the $KMnO_4$ concentrations at the 2-minute and 30-minute marks.

- The neutralization of the rotenone laden water from the outlet would last from 14 to 45 day days depending on rate of the breakdown of the rotenone in the reservoir.
- Water samples at the 2-minute and 30-minute marks would be analyzed with a colorimeter to verify that $KMnO_4$ concentrations are at target levels.
- The 2-minute station target is the calculated concentration necessary to neutralize anticipated rotenone concentrations in Lake Davis.
- The 30-minute mark target concentration of 0.5 to 1.0 mg/L $KMnO_4$ verified by bi-hourly colorimeter samplings.
- A backup 2.5% solution $KMnO_4$ reservoir would be ready for use should volumetric auger system fail.
- Water samples will also be collected bi-hourly for laboratory analysis for parameters outlined in the water quality monitoring plan.
- The neutralization and water pumping station would be continuously monitored to ensure that every component is functioning properly.
- The operation of the instream neutralization would continue until fish are able to survive in Lake Davis.

Alternative 4

This option examines the instream neutralization similar to alternative 3, except that there would be 3 to 5 cfs from the dam with no initial flow shutoff.. This option would shut off the release flows from Grizzly Valley Dam with only the leakage flows (≈ 4 gpm from the base of the dam) occurring for up to 5 days after the application of rotenone begins in Lake Davis. The cessation of flows would allow the rotenone formulation in the reservoir to completely mix thereby reducing the chances for higher concentration plumes of rotenone to pass downstream through the neutralization station. Water sampling results from Lake Davis in 1997 indicated that the reservoir completely mixed within 24 to 48 hours after the application of rotenone. After 5 days, the instream flow releases to Big Grizzly Creek would be resumed at 3 to 5 cfs. This option would require employing the same technology as Option 3 to dispense the granular potassium permanganate into the stream. A backup system using 2.5% solution $KMnO_4$ would also be required for this option. Due to the higher volume of flow discharging from the dam, the rates of granular or 2.5% solution $KMnO_4$ would be increased to ensure complete neutralization of the rotenone. The target concentration at the 30-minute mark would remain at 0.5 to 1.0 mg/L $KMnO_4$. The target concentration at the 2-minute mark would be the same as the calibrated discharge concentration of $KMnO_4$ from the auger or slurry reservoirs. This option would require that approximately 6,500 pounds of potassium permanganate be onsite to complete the neutralization.

Sentinel fish would be located between the dam and the neutralization station, at the 15-minute flow travel mark, at the 30-minute mark, and at the 60-minute mark. The sentinel fish would be provided by a DFG hatchery and held nearby for continual restocking of the live cars throughout the duration of the neutralization operation. The live cars would contain 3 to 5 fish each. The live cars would be located in slack water areas to reduce stress levels. The fish located between the dam and the neutralization site would be replenished once per day to ensure that toxicity is still occurring in the release flows. Fish at the 15-minute and 30-minute marks would be checked every 2 to 4 hours and stressed, injured, or dead fish would be replaced as necessary. Fish at the 60-minute mark would be checked every 6 hours. All fish would be replaced daily.

Approximately 24 hours prior to the application of rotenone in Lake Davis, the application of granular potassium permanganate would begin. This would allow the pre-oxidization of the neutralization zone downstream of the dam to the 30-minute mark (distance = ≈1/3 mile). Potassium permanganate would be discharged at 2 to 5 mg/L to ensure that the full range of delivery is tested. The 2.5% $KMnO_4$ slurry solution would also be tested after the granular tests are performed. The 2.5% solution would be released at 2 to 5 mg/L to ensure that the valves on the slurry reservoirs are properly calibrated. Concentrations of dissolved $KMnO_4$ would be measured and recorded at the 2-minute and 30-minute marks every ¼-hour using a colorimeter.

Approximately 4 to 8 hours prior to the application of rotenone in Lake Davis, the application of granular potassium permanganate would begin. Discharge of the granular potassium permanganate would be measured using an electronic balance bi-hourly. Volumetric discharge of the granular potassium permanganate would be dependant upon the constant feedback of the $KMnO_4$ concentrations at the 2-minute and 30-minute marks.

- The neutralization of the rotenone laden water from the outlet would last from 14 to 45 days depending on rate of the breakdown of the rotenone in the reservoir.
- Water samples at the 2-minute and 30-minute marks would be analyzed with a colorimeter to verify that $KMnO_4$ concentrations are at target levels.
- The 2-minute station target is the calculated concentration necessary to neutralize anticipated rotenone concentrations in Lake Davis.
- The 30-minute mark target concentration of 0.5 to 1.0 mg/L $KMnO_4$ would be verified by bi-hourly colorimeter samplings.
- A backup 2.5% solution $KMnO_4$ reservoir would be ready for use should volumetric auger system fail.
- Water samples will also be collected bi-hourly for laboratory analysis for parameters outlined in the water quality monitoring plan.
- The neutralization and water pumping station would be continuously monitored to ensure that every component is functioning properly.
- The operation of the instream neutralization would continue until fish are able to survive in Lake Davis.